

## **REMARKS**

Applicants have amended Claims 1, 3, 10 and 11 and have cancelled Claims 7-9. Applicants submit no new matter has been added by the present amendment.

### **I. Rejection under 35 U.S.C. § 112**

Claims 1-3 and 7-11 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention.

Applicants have amended the claims to be directed to rubber mixtures consisting of components A, B and C, thereby excluding any element, step, or ingredient not specified in the claim. See MPEP 2111.03. Applicants submit that it is for the inventor to decide what bounds of protection he will seek and he has the right to retreat to otherwise patentable subject matter because only part of what was originally claimed is patentable. In re Johnson, 194 USPQ 187, 195-96 (CCPA 1977).

Applicants have resubmitted a copy of the Appendix, which was sent, with the Response and Amendment dated April 4, 2003. As noted, there are various forms of formaldehyde, including, gaseous formalin, paraformaldehyde, trioxane and hexamethylene tetramine. See pages 604 - 606, specifically, Table 3, of Kirk-Othmer, Encyclopedia of Chemical Technology 4th, Ed., Volume 18. If the Appendix is misplaced again by the Patent and Trademark Office, prior to receipt by the Examiner, Applicants respectfully request the Examiner phone the Applicants Patent Attorney at 412-777-3879.

Applicants have removed NBR from Claim 3 as suggested in the Office Action.

Applicants respectfully request that in view of the claim amendment and arguments above the rejections under 35 U.S.C. § 112 be withdrawn.

### **II. Rejection under 35 U.S.C. §103(a)**

Claims 1-3, 7, 8 10 and 11 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Doran, Jr. et al. (U.S. Patent No. 3,821,133) in view of Obrecht, et al. (U.S. Patent No. 6,127,488). Applicants respectfully traverse this ground of rejection.

Applicants respectfully submit that "in order to establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference. Second, there

must be a reasonable expectation of success. Finally, the **prior art references must teach or suggest all the claims limitations**. The teachings or suggestions to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicants' disclosure." See MPEP § 2142, citing In re Vaeck, 947 F.2d 488, 20 USPQ 2d. 1438 (Fed. Cir. 1991).

The present invention is directed to rubber compounds **consisting of** uncrosslinked, double bond-containing rubbers (A), crosslinked rubber particles (B) and a mixture of resorcinol and formaldehyde (C), wherein the double bond-containing rubbers (A) are present in quantities of 100 parts by weight, the crosslinked rubber particles (B) in quantities of 10 to 150 parts by weight and (C) in quantities of 0.1 to 50 parts by weight, and wherein the crosslinked rubber particles (B) are selected from the group consisting of BR, ABR, IR, SBR, X-SBR, SIBR, FKM, ACM, ENR, NR, CR, IIR, BIIR, CIIR, EPM, EPDM, EAM, AVM, CO, ECO, Q, AU and EU and wherein the formaldehyde is in the form of paraformaldehyde or hexamethylene tetramine.

Applicants respectfully submit that Doran, Jr. et al. fails to teach or suggest the claimed invention. Doran, Jr. et al. discloses a rubber composition, **which comprises** SBR, BR, EPDM or NR with a mixture comprising **an aromatic hydroxy compound, a methylene donor and an amino compound**. According to the disclosure of Doran, Jr. et al. the compound has a **plurality of amino groups**, i.e. a polyimine. According to Doran, Jr. et al. the desirable physical properties (improved tensile strength, shortened cure time, increased 300 percent modulus, and resistance to abrasion) of the rubber compound disclosed therein is achieved adding to a conventional rubber compound, polyimine, an aromatic hydroxy compound, silica and preferably a methylene donor.

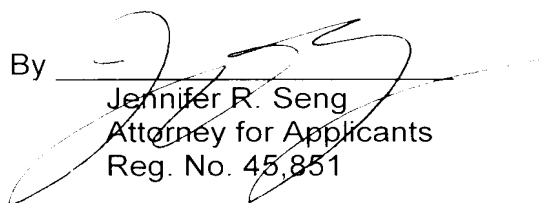
The amended claims of the present invention do not include the essential ingredients disclosed by Doran, Jr. et al., i.e., polyamine or polyimine compounds and silicious pigments. The amended claims are directed to rubber compounds, which **consist of** uncrosslinked, double bond-containing rubbers (A), crosslinked rubber particles (B) and a mixture of resorcinol and formaldehyde (C). And as disclosed at page 2, lines 10-14 of the pending application, the use of phenolic resin adducts and of condensed phenolic resins to improve the mechanical properties (modulus, elongation at break, tear strength) without impairing the processability (compound viscosity) of rubber compounds containing rubber gels is not taught.

Accordingly, Applicants submit that Doran, Jr. et al. fails to teach or suggest the pending claims. Further Applicants submit that Doran, Jr. et al. in view of Obrecht, et al. fails to render the present claims obvious, because as discussed the primary reference does not teach a rubber compound consisting of the ingredients claimed and those deficiencies are not overcome by combination with Obrecht, et al. Obrecht, et al. merely teaches a rubber compound comprising at least one styrene/butadiene rubber gel and at least one rubber which contains double bonds. Obrecht, et al. does not teach or suggest a rubber compound consisting of the claimed ingredients.

For at least these reasons, Applicants request withdrawal of this ground of rejection and early allowance of Claims 1-3, 10 and 11.

Respectfully submitted,

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## APPENDIX

**ENCYCLOPEDIA OF**

**CHEMICAL**

**TECHNOLOGY**

**VOLUME 18**

**FOURTH EDITION**

KIRK-OTHMER

# ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY

FOURTH EDITION

VOLUME 18

PAPER  
TO  
PIGMENT DISPERSIONS



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Table 1. Properties of Phenol

Property	Value
mol wt	94.1
mp, °C	40.9
bp, °C	181.8
flash point, °C	79.0
autoignition temperature, °C	605.0
explosive limits, vol %	2-10
vapor pressure at 20°C, Pa <sup>a</sup>	20

<sup>a</sup>To convert Pa to mm Hg, multiply by  $7.5 \times 10^{-3}$ .

nitrogen blanket to prevent the formation of pink quinones. Iron contamination results in a black color.

The most widely used process for the production of phenol is the cumene process developed and licensed in the United States by AlliedSignal (formerly Allied Chemical Corp.). Benzene is alkylated with propylene to produce cumene (isopropylbenzene), which is oxidized by air over a catalyst to produce cumene hydroperoxide (CHP). With acid catalysis, CHP undergoes controlled decomposition to produce phenol and acetone;  $\alpha$ -methylstyrene and acetophenone are the by-products (12) (see CUMENE; PHENOL). Other commercial processes for making phenol include the Raschig process, using chlorobenzene as the starting material, and the toluene process, via a benzoic acid intermediate. In the United States, ~35-40% of the phenol produced is used for phenolic resins.

**Substituted Phenols.** Phenol itself is used in the largest volume, but substituted phenols are used for specialty resins (Table 2). Substituted phenols are typically alkylated phenols made from phenol and a corresponding  $\alpha$ -olefin with acid catalysts (13). Acidic catalysis is frequently in the form of an ion-exchange resin (IER) and the reaction proceeds preferentially in the para position. For example, in the production of *t*-butylphenol using isobutylene, the product is >95% para-substituted. The incorporation of alkyl phenols into the resin reduces reactivity, hardness, cross-link density, and color formation, but increases solubility in nonpolar solvents, flexibility, and compatibility with natural oils.

**Formaldehyde.** In one form or another, formaldehyde is used almost exclusively in the production of phenolic resins, regardless of the type of phenol (Table 3). It is frequently produced near the site of the resin plant by either

Table 2. Substituted Phenols Used for Phenolic Resins

Substituted phenol	Resin application
cresol ( <i>o</i> -, <i>m</i> -, <i>p</i> -)	coatings, epoxy hardeners
<i>p</i> - <i>t</i> -butylphenol	coatings, adhesives
<i>p</i> -octylphenol	carbonless paper, coatings
<i>p</i> -nonylphenol	carbonless paper, coatings
<i>p</i> -phenylphenol	carbonless paper
bisphenol A	low color molding compounds, coatings
resorcinol	adhesives
cashew nutshell liquid	friction particles

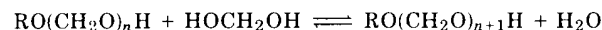
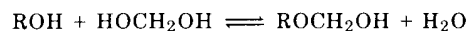
Table 3. Forms of Formaldehyde

Type	Chemical formula	Resin preparation	
		Advantages	Disadvantages
gaseous	CH <sub>2</sub> O		unstable
formalin			
36 <sup>c</sup> %	HO(CH <sub>2</sub> O) <sub>n</sub> H <sup>a</sup>	easy handling, moderate reactivity, stable at RT	high water content
50 <sup>c</sup> %	HO(CH <sub>2</sub> O) <sub>n</sub> H <sup>b</sup>	increased capacity	elevated temperature storage, formic acid formation
paraformaldehyde	HO(CH <sub>2</sub> O) <sub>n</sub> H <sup>c</sup>	increased capacity, water-free	dangerously high reactivity, solids handling
trioxane	(CH <sub>2</sub> O) <sub>3</sub>	water-free	catalyst requirements, high cost
hexamethylene-tetramine	(CH <sub>2</sub> ) <sub>6</sub> N <sub>4</sub>	autocatalytic	amine incorporation

<sup>a</sup>*n* ≈ 2.<sup>b</sup>*n* ≈ 3.<sup>c</sup>*n* = 20–100.

of two common processes using methanol (qv) as the raw material. In the silver catalyst process, the reaction takes place at 600–650°C and produces water and hydrogen as by-products. The more common metal oxide process operates at 300–400°C. The gaseous formaldehyde is absorbed in water, the final product is a formalin solution containing 36–50% formaldehyde. Of the various chemical forms of formaldehyde, the aqueous form is preferred for making phenolic resins, even though at least half of this form is water. The water serves to moderate the reaction and is readily removed in processing equipment (14) (see FORMALDEHYDE).

**Aqueous Formaldehyde.** Water solutions of formaldehyde consist mainly of telomers of methylene glycol having <100 ppm of the formaldehyde as CH<sub>2</sub>O (5). Alcohols form hemiformals with aqueous formaldehyde according to the following, where *n* = 1, 2, 3, etc.



However, a second mole of alcohol or hemiformal cannot be added at the ordinary pH of such solutions. The equilibrium constant for hemiformal formation depends on the nature of the R group of the alcohol. Using nmr spectroscopy, a group of alcohols including phenol has been examined in solution with formaldehyde (15,16). The spectra indicated the degree of hemiformal formation in the order of methanol > benzyl alcohol > phenol. Hemiformal formation provides the mechanism of stabilization; methanol is much more effective than phenol in this regard.

The large value for the hemiformal formation constant of methanol and its low molecular weight explains the high efficiency of methanol in stabilizing



**Other Aldehydes.** The higher aldehydes react with phenol in much the same manner as formaldehyde, although at much lower rates. Examples include acetaldehyde,  $\text{CH}_3\text{CHO}$ ; paraldehyde,  $(\text{CH}_3\text{CHO})_3$ ; glyoxal,  $\text{OCH}-\text{CHO}$ ; and furfural. The reaction is usually kept on the acid side to minimize aldol formation. Furfural resins, however, are prepared with alkaline catalysts because furfural self-condenses under acid conditions to form a gel.

**Hexamethylenetetramine.** Hexa, a complex molecule with an adamantane-type structure, is prepared from formaldehyde and ammonia, and can be considered a latent source of formaldehyde. When used either as a catalyst or a curative, hexa contributes formaldehyde-residue-type units as well as benzylamines. Hexa [100-97-0] is an infusible powder that decomposes and sublimes above 275°C. It is highly soluble in water, up to ca 45 wt % with a small negative temperature solubility coefficient. The aqueous solutions are mildly alkaline at pH 8–8.5 and reasonably stable to reverse hydrolysis.

**Other Reactants.** Other reactants are used in smaller amounts to provide phenolic resins that have specific properties, especially coatings applications. Aniline had been incorporated into both resoles and novolaks but this practice has been generally discontinued because of the toxicity of aromatic amines. Other materials include rosin (abietic acid), dicyclopentadiene, unsaturated oils such as tung oil and linseed oil, and polyvalent cations for cross-linking.

Phenolic resins are prepared with strong acid or alkaline catalysts. Occasionally, weak or Lewis acids, such as zinc acetate, are used for specialty resins.

**Strong-Acid Catalysts, Novolak Resins.** Phenolic novolaks are thermoplastic resins having a molecular weight of 500–5000 and a glass-transition temperature,  $T_g$ , of 45–70°C. The phenol–formaldehyde reactions are carried to their energetic completion, allowing isolation of the resin; formaldehyde–phenol molar ratios are between 0.5:1 and 0.8:1. Methylene glycol [463-57-0] (**1**) is converted to the corresponding hydrated carbonium ion (**2**), which adds to the ortho and para positions of phenol with the elimination of water to form the corresponding ortho (**3**) and para (**4**) benzylic ions. The benzylic carbonium ions are in equilibrium with the corresponding benzylic alcohols, observed by nmr as transient species in the formation of novolak resins (15).

